



The Plant Growth Simulator

Elementary Version

*Student
Workbook*

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Introduction

You are about to use a computer program called *The Plant Growth Simulator: Elementary Version*. The word simulate is another word for imitate. In other words, this program tries to imitate the way a plant grows.

It would be very difficult for you to stand outside and watch how plants grow. Why would this be so hard?

First of all, some of the time a plant is growing, it is underground. You can't even see what is happening.

Also it takes a long time for a plant to grow. Imagine trying to watch a bulb that you have planted in your garden turn into a tulip!

There are also many things that happen inside a plant. The plant parts are often very small and sometimes difficult to see.

This computer program will try to make it easier for you to understand how a plant grows. You will learn about the way flowers, fruit, vegetables, and trees grow.

The program is very easy to use. There are a few instructions which will be helpful to you. You will be able to read them on the monitor while you are using the program. We have also put them on the next page so that you can keep them with you whenever you use the program.

The Plant Growth Simulator

Instructions for Using The Plant Growth Simulator

Every time you use *The Plant Growth Simulator*, begin by following these instructions.

1. Place the disk you are using into the correct disk drive. If you have two disk drives, place the disk in drive one. Make sure the computer and the monitor are turned on.
2. Press the RETURN key after the title screen appears.
3. You will be asked whether you want to read the text screens. If your teacher has asked you to read them, press Y. Otherwise, press N.
4. Now you will see the Main Menu. This tells you what your choices are for this disk. Choose the number next to the item your teacher tells you to pick. If your teacher did not give you instructions, do them in order. Anytime you want to go back to the Main Menu, press the ESCAPE key.
5. Each program gives you two choices. You can look at the program in steps or as moving pictures.
 - A. To look at the program in steps, press S. Then you will see a picture. Each time you want to see the next picture, press the space bar. When the program is over, you will be asked whether you want to repeat it. Just press Y for yes or N for no.
 - B. To look at the program as moving pictures, press M. When the Program is over, you will be asked whether you want to repeat it. Just press Y for yes or N for no.
6. Here is a review of the special keys you should know about when you use *The Plant Growth Simulator*.

ESCAPE — if you want to return to the Main Menu
S — if you want to watch a program one picture at a time
M — if you want to watch the program in motion
7. While you are viewing each program, answer the questions on the worksheet that goes with that part of the program.

Glossary

This glossary defines important words found in the programs. You will find it helpful as you look at the programs and answer the worksheet questions.

anther: the part that makes pollen. The anther is on the tip of the stamen.

bulbs: a short thick underground stem with scales and leaves around it. Food is stored in these leaves. Tulips and onions grow from bulbs.

cotyledons: another name for seed leaves. Cotyledons provide food for a young plant until the first true leaves form.

cross-pollination: pollination that happens when pollen is carried from the male part of a flower on one plant to the female part of a different plant. Cross-pollination happens because of animals, such as insects, or by the wind.

dicot: a plant with two seed leaves. A bean plant is a dicot.

fertilization: what happens when a sperm (the male cell) joins with an egg (the female cell) in a flower. Fertilization helps new flowers to be created.

filament: the part of a flower that supports the anther. The filament of a flower is long and thin.

fruit: forms after pollination and fertilization are complete. It is designed as a package for spreading the seeds it contains. The beautiful flower blossom turned into a delicious fruit.

geotropism: what happens when plants respond to the earth's gravity. The plant roots grew down because of geotropism.

germination: the growth of a new plant from a seed. During germination the seed began to grow into a plant.

hydrotropism: what happens when plants respond to water in the soil. The roots of the plant grew towards the wet part of the soil because of hydrotropism.

insect pollination: pollination that happens when an insect leaves pollen on the pistil. When a bee moves pollen from one flower to another, insect pollination takes place.

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Glossary continued

monocot plants: plants with only one seed leaf. A corn plant is an example of a monocot plant.

ovary: the bottom of the pistil; forms fruit. Fertilization takes place in the ovary.

ovules: the parts that form seeds inside the ovary. Ovules are another name for egg cells.

petals: the colorful leaves that surround a flower. The colorful flower petals attract insects to them.

phototropism: what happens when a plant responds to light. The leaves and stems of the plant bend towards the light because of phototropism.

pistil: the female part of a flower. During pollination, pollen is carried from the stamen to the pistil.

pollen: tiny grains from the stamen. It carries the sperm. A bee carries pollen on its body from flower to flower.

pollination: what happens in plants when pollen from the male part (the stamen) lands and sticks on the female part (the pistil). Pollination can happen in the same flower or between different flowers.

roots: the part of the plant that holds it in the soil. The roots are at the bottom of a plant.

rhizomes: thick stems that grow slightly beneath the surface of the soil. The iris grows into a flower from rhizomes.

runners: above ground stems that may grow out of the root of a plant. Strawberries spread out on the ground from runners.

seed: After the egg is fertilized, it grows into an embryo with its own tissues and organs. It is covered by a coat to protect itself. This embryo and coat are called a seed. A seed grows into a plant.

seed leaves: small leaves that form from seeds. Seed leaves provide food for the young plant until the first true leaves form.

seedlings: new plants. The new seedlings looked like little trees.

self-pollination: pollination that happens when pollen moves from the male part to the female part of the same flower. When pollen falls from the stamen on one flower to the pistil on the same flower, self-pollination has taken place.

sepals: the leaves that protect a flower before it opens. Sepals are usually found at the bottom of an open flower.

stamen: the male part of a flower. The sperm form in the stamen.

stigma: the sticky top of the pistil. Pollen lands on the stigma of a flower.

style: the long and thin part of the pistil. The style is just below the top of the pistil.

thigmotropism: what happens when plants respond to touch. When a bean plant climbs a pole, thigmotropism is happening.

tropism: what happens when a plant responds to its surroundings. The way a plant responds to light, touch, gravity, or water are all examples of a tropism.

tubers: a stem that is thicker in a certain place and grows underground. The potato is an example of a tuber.

The Plant Growth Simulator

Worksheet 1

Pollination

Disk I, Side 1

Name _____ Date _____

1. The male part of a plant is called the _____.
2. The female part of a plant is called the _____.
3. Name three things that can help pollination.

1. _____
2. _____
3. _____

Wind Pollination

4. True or False—Pollen may be carried from one plant to a different kind of plant. _____
5. Did some of the pollen land right on the flowers of the plant? _____
6. How does the wind help the pollen to get from one plant to another?

Insect Pollination

7. What attracts an insect to a flower? _____
8. When an insect flies away from a flower, it sometimes carries _____.
9. When you watch the bee leave pollen on the flower, it leaves it on _____
A. the stamen. B. the pistil. C. the petals.

Self-Pollination

10. True or False—Self-pollination happens when pollen moves from one flower to another. _____

Cross-Pollination

11. Cross-pollination happens when pollen is carried from the _____ of one flower to the _____ of another flower.

Worksheet 2

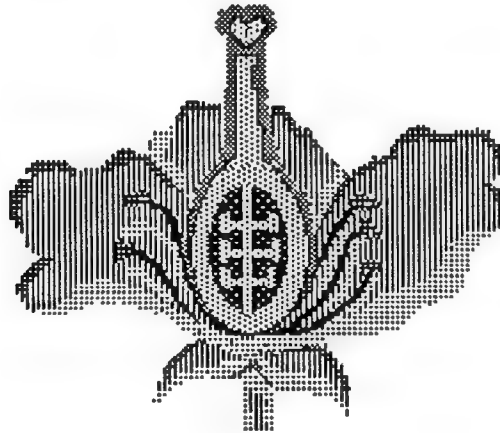
Fertilization and Fruit Formation

Disk I, Sides 1 and 2

Name _____ Date _____

Fertilization

1. Fertilization happens when a _____ joins with an _____.
2. The pollen carrying the sperm sticks to the top of the _____.
3. A tube forms and the sperm moves around the part of the pistil called the _____.
4. After a sperm and egg join, they begin to form a _____.
5. Draw the path of the pollen tube on the flower below.

**Fruit Formation**

6. What happens to the flower petals after pollination and fertilization are finished? _____

7. What will a bird find inside a fruit? _____

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Worksheet 3

Spreading Seeds

Disk 1, Side 2

Name _____ Date _____

1. The reason that plants spread their seeds is so that _____.
2. New plants are called _____.
3. The reason that new plants cannot grow near older plants is that the young plants would not get enough _____ or _____.

Dandelion

4. What helps dandelion seeds to spread? _____
5. The shape of the top of dandelion seeds makes them act like a _____.

Flying Bird

6. Name two ways that birds can carry seeds.

1. _____
2. _____

Maple Wings

7. The seeds from maple trees are shaped like _____.

Coconut

8. True or False—A coconut is a fruit that can float in water. _____
9. _____ can carry a coconut to where a new plant may grow.

Touch-Me-Not

10. Which of the following is true? _____
 - A. The seeds of a touch-me-not are shaped like parachutes.
 - B. The seeds of the touch-me-not do not travel very far.
 - C. The fruit of the touch-me-not pops open and seeds burst out.

Worksheet 4

Plant Growth

Disk II, Side 1

Name _____ Date _____

1. New plants may begin to grow from _____ or _____
_____.
2. Which of the following plant parts grow while a plant is underground? ____
A. petals and stamens
B. pistils and stamens
C. roots and stems

Germination

3. True or False—Seeds can remain underground for a long time. _____
4. The growth of a new plant from a seed is called _____
5. Name three things that need to be right for a new plant to start growing.
1. _____ 2. _____
3. _____
6. What part holds a plant in the soil? _____

Bean Plant: Dicot

7. The seed leaves in bean plants are called _____.
_____.
8. When the stem of a bean plant sprouts, the seed leaves _____
A. grow larger.
B. shrink.
C. stay the same size.

Corn Plant: Monocot

9. Plants with only one seed leaf are called _____ plants.
10. A _____ grows into the soil.
11. The plant _____ grows upward through the soil.

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Worksheet 5
How Plants Respond
Disk II, Side 1

Name _____ Date _____

Plants Respond to Light

1. The word for plants' response to light is called _____.
2. Which statement is true? _____
 - A. Plant stems and leaves bend toward light as they grow.
 - B. Plant stems and leaves bend away from light as they grow.
 - C. Plant stems and leaves don't bend toward or away from light.

Plants Respond to Touch

3. The word for plants' response to touch is _____.
4. True or False—A Venus flytrap closes around insects. _____
5. True or False—The stem of a bean plant grows away from a pole.

Plants Respond to Gravity

6. The word for plants' response to gravity is called _____.
7. True or False—The stem of a growing plant will grow towards the force of gravity. _____
8. On a mountainside, some plants respond to gravity. Their roots grow toward the _____.
Their stems grow _____.

Plants Respond to Water

9. The word for plants' response to water is called _____.
10. The _____ of a plant respond to water.
11. According to the simulation, if water falls on one side of a plant, _____.
 - A. the roots grow more on the other side.
 - B. the roots grow the same on both sides.
 - C. the roots grow more on the same side as the water.

Worksheet 6

Growing Plants Without Seeds

Disk II, Side 2

Name _____ Date _____

Runners

1. Runners grow out of the _____ of a plant.
2. When a bud on a runner touches the soil, _____
A. the plant will die. B. a new plant will begin to grow.
C. the leaves change color.
3. While a runner on a strawberry plant is growing, do new strawberries grow also? _____

Rhizomes

4. An example of a plant that is a rhizome is _____
A. a tulip. B. a strawberry. C. an iris.
5. True or False—Rhizomes grow new stems and leaves. _____
6. Does more than one plant grow from the original rhizome? _____

Bulbs

7. _____ is stored in the scales or leaves of a bulb.
8. An example of a plant that grows from a bulb is _____
A. a rose. B. a marigold. C. a tulip.
9. True or False—New bulbs grow from a bulb. _____

Tubers

10. True or False—A tuber grows above the ground. _____
11. The parts of the tuber that produce new potato plants are called the _____.
12. True or False—Only one potato can grow from a tuber. _____

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Worksheet 7
Parts of the Flower
Disk II, Side 2

Name _____ Date _____

You can do this part while using the computer or at your desk. If you are using the computer, go to the program called "Parts of the Flower." Then choose A from the menu. Read the screen called "Parts of the Flower," and then answer these questions.

1. The _____ is the part of a plant that produces the seeds.
2. List two things that seeds contain.
 1. _____
 2. _____
3. Now press the RETURN key and look at the picture of the flower. Notice that it has a box around a flower part. The name of that flower part is in a box to the left of the flower. It says "stigma."

Below the picture of the flower, you can read about that flower part. It says "the sticky part of the pistil." So, on this worksheet, in the correct space below, you would write in the word, "pistil" before the correct description. Fill in the remaining blanks while using the space bar to see the other flower parts.

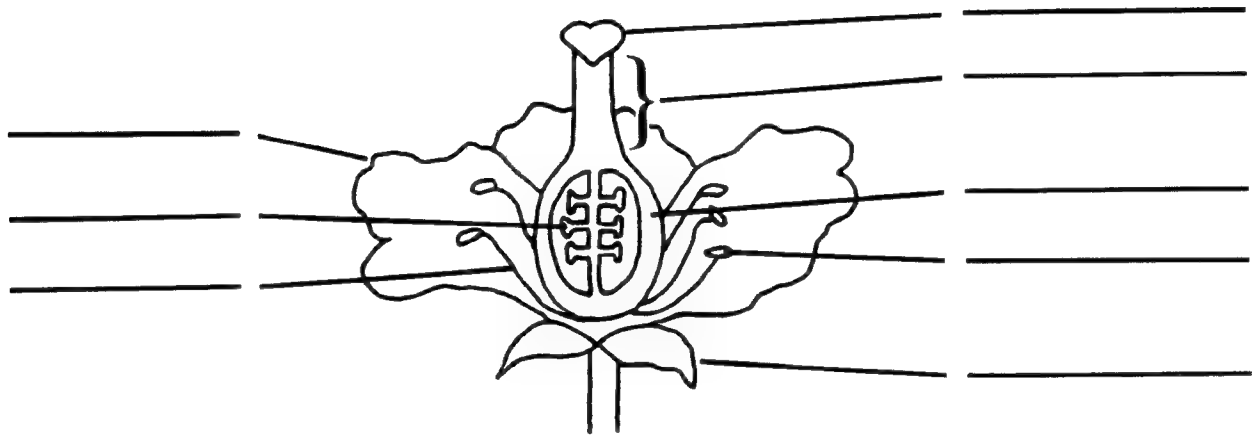
Fill in the blank spaces:

Flower Part	Information About the Part
stigma	the sticky top of the pistil
	the long and thin part of the pistil
	the bottom of the pistil; forms fruit
	form seeds inside the ovary
	leaves that protect a flower before it opens
	the flower part that makes pollen
	the part that supports the anther
	colorful leaves of a flower

Worksheet 8
Parts of the Flower
 Disk II, Side 2

Name _____ Date _____

Below is a picture of a flower just like the one you can see in the computer program. See how good you are at labelling each part of the flower. Write the names of the parts on the lines.



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Worksheet 9 Crossword Review Disk I

Name _____ Date _____

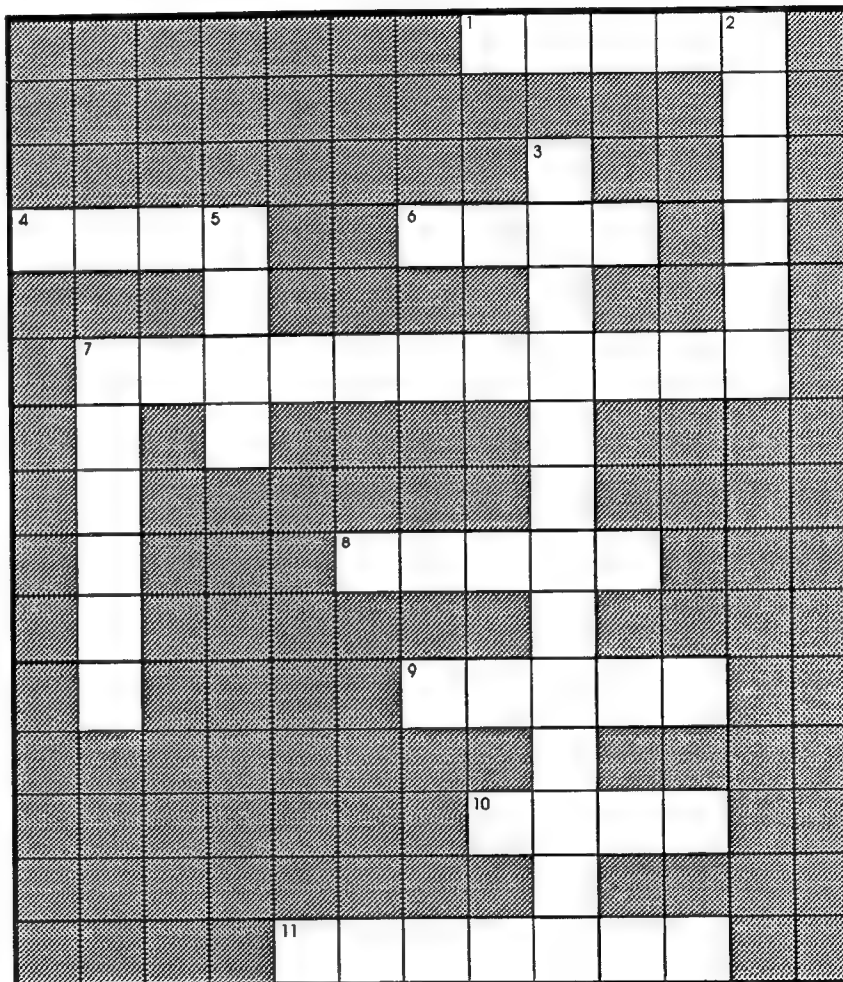
To help you do this crossword puzzle, you might want to use your glossary.

Down

2. The male part of a flower.
3. When a sperm joins with an egg in a flower.
5. Pollination that happens in the same flower.
7. The brightly-colored parts of flowers that attract insects.

Across

1. Pollination that happens between two different flowers.
4. Insects that help carry pollen to flowers.
6. Grows into a plant.
7. What happens when pollen moves from the male part to the female part.
8. Forms after pollination and fertilization are complete.
9. The sperm and egg in a flower join together here.
10. Something that carries pollen from one flower to another.
11. A covered fruit that floats on water.



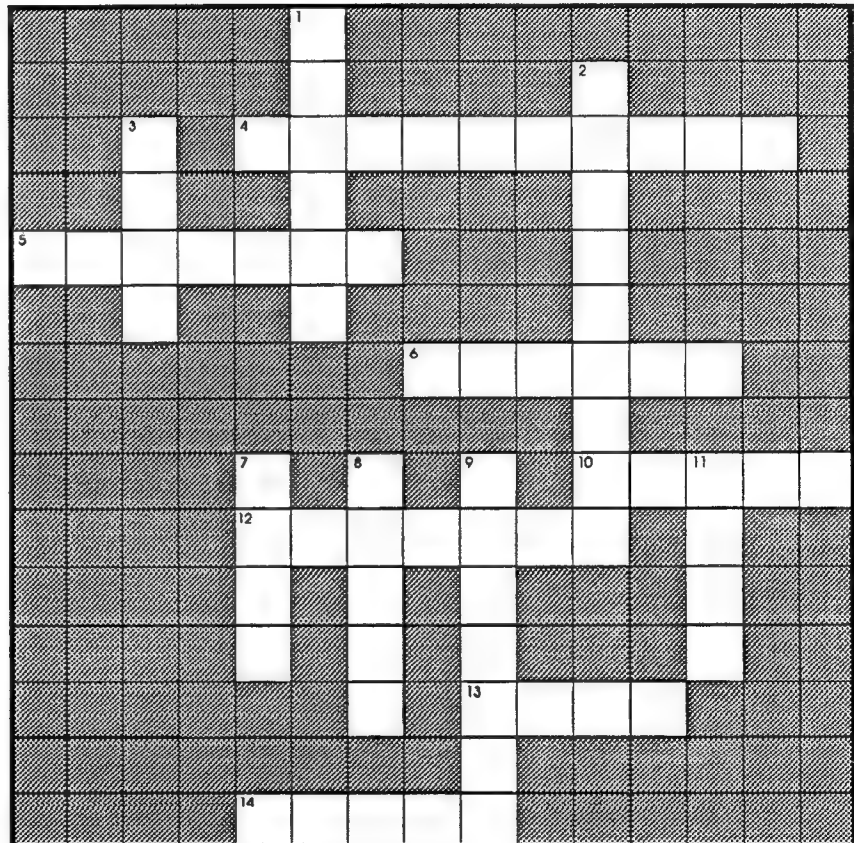
Worksheet 10
Crossword Review
 Disk II

Name _____ Date _____

To help you do this crossword puzzle, you might want to use your glossary.

Down

1. An eye or bud on a tuber grows into this vegetable.
2. When seeds begin to grow they _____.
3. This kind of plant forms from seeds with two small leaves.
7. This flower grows from rhizomes instead of seeds.
8. Phototropism is what happens when a plant responds to _____.
9. A plant with only one seed leaf.
11. A tulip grows from this stem that stores food in its leaves.



Across

4. This fruit comes from a plant that grows from runners.
5. Geotropism is what happens when plants respond to _____.
6. An above ground stem that grows out of a plant root.
10. A stem that is thicker in a certain place and grows underground.
12. Irises grow from this thick underground stem.
13. Plants with only one seed leaf.
14. Plants with two seed leaves.

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Worksheet 11 Word Search Puzzle

Name _____ Date _____

Ten of the words in the list below are hidden in this puzzle. The words may be forwards, backwards, up, down, or diagonal.



runners	stamen	seedlings
fertilization	pollen	pistil
dicot	filament	thigmotropism
germination	ovary	phototropism
anther	rhizomes	bulbs
cotyledons	tubers	geotropism
stigma		sepals

Worksheet 12

Complete the Paragraph

Disk I

Name _____ Date _____

After you have finished with *The Plant Growth Simulator*, try to complete each of the paragraphs below using the list of words.

animals	pistil	stamen
coconut	pollen	touch-me-not
egg	seed	water
ovary	seedlings	wind
parachute	sperm	wing

1. Pollination happens in plants when _____ moves from the male part to the female part of a flower. The male part is called the _____ and the female part is called the _____. Three things that help pollination are _____, _____, and _____.
2. Fertilization happens when a _____ (which is the male cell) joins with an _____ (which is the female cell). A tube forms, and the sperm moves around the lower and fatter part of the pistil called the _____. After the male cell and the female cell join, they begin to form a _____.
3. Plants spread their seeds so that new plants can grow. The new plants are called _____. The wind helps to spread dandelion seeds. The shape of the top of the seed acts like a _____. The maple tree spreads its seeds with a _____-shaped fruit. They make the seed spin away from the tree branch. The _____ floats in water until it is carried to a new beach where a new plant may grow. The _____ plant has a fruit that pops open letting the seeds burst from its pods.

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Worksheet 13

Complete the Paragraph

Disk II

Name _____ Date _____

After you have finished using *The Plant Growth Simulator*, try to complete each of the stories below using the list of words.

air	germination	roots
bean	hydrotropism	runners
bulbs	moisture	stem
corn	monocot	temperature
dicot	phototropism	thigmotropism
geotropism	rhizomes	tubers
	Venus flytrap	

1. The growth of a new plant from a seed is called _____. Seeds will begin to grow when the _____, _____, and _____ in the soil are right. The _____ begin to grow first. They hold the plant in the soil as the _____ grows up through the ground.
2. Some plants have seeds that form two small leaves. Plants with these two seed leaves are called _____ plants. Plants with only one seed leaf are called _____ plants. An example of a plant with two seed leaves is the _____ plant. A plant that has only one seed leaf is the _____ plant.
3. Plants grow toward light. When they do this, it is called _____. Some plants respond to touch. This is called _____. A plant that curls around insects when they land is called the _____. When plants respond to gravity, it is called _____. The roots of a plant, for example, grow down while the stem grows up. When a plant responds to water this is called _____. The roots of a plant will grow faster on the side of the plant closest to the water.
4. Many plants grow without seeds. A strawberry plant is an example of a plant that can grow from _____. An iris grows from thick stems beneath the soil called _____. Onions and tulips grow from _____. The potato actually forms underground from certain kinds of stems called _____.

Worksheet 14

Creative Writing

Name _____ Date _____

Here are some creative writing ideas. Use your imagination, and write your composition(s) on notebook paper.

1. Pretend you are a bee. Write about what it is like to move from flower to flower. How does it feel to know that you are helping plant pollination?
2. Pretend that you are a grain of pollen that has just landed on a flower. Describe what happens to you while you form a seed through fertilization.
3. Pretend that you are a dandelion. Describe what happens to you as you grow. How do you spread your seeds?
4. Pretend that you are a plant seed. What needs to happen for you to grow in the right way?
5. Pretend that you are a plant near a window. What does it feel like to grow towards the light?
6. Pretend that you are a tulip bulb. Describe what happens to you as you are planted. What does it feel like to grow into a tulip?



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